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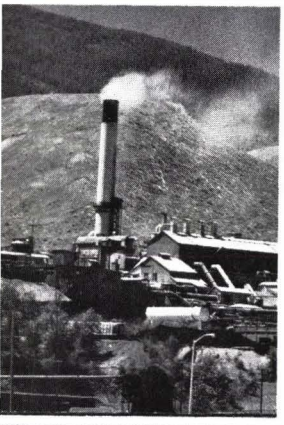

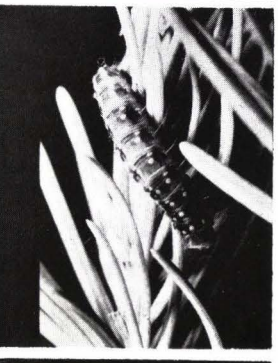

FOREST INSECT & DISEASE MANAGEMENT

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AN EVALUATION OF A DEVELOPING MOUNTAIN PINE BEETLE INFESTATION IN CENTENNIAL VALLEY, MONTANA, 1979

By

K. E. Gibson and M. D. McGregor, Entomologists
and
D. D. Bennett, Biological Technician

ABSTRACT

The mountain pine beetle infestation on Bureau of Land Management lands in Centennial Valley has increased from about 500 acres in 1977 to more than 7,000 in 1979. Average number of trees per acre killed has more than quadrupled, increasing from 9.8 in 1977 to 47.8 in 1979. Predictions for the future of the infestation, plus management alternatives to lessen the severity of the outbreak are discussed.

INTRODUCTION

The mountain pine beetle epidemics now extant in southwestern Montana and southeastern Idaho began nearly 20 years ago as beetle populations built rapidly in vast expanses of mature and overmature lodgepole pine. Though such epidemics are cyclic, and have been an important part of the lodgepole pine ecosystem throughout its history, no previously recorded epidemic has had such a devastating effect on timber inventories.

A multiphase damage assessment survey conducted on the Targhee National Forest in 1977 showed more than 21 million standing dead trees killed by the mountain pine beetle on approximately 400,000 acres (Klein et al. 1979). On the Island Park Ranger District of the Targhee National Forest, which is adjacent to Centennial Valley on the east, a 5-year trend survey indicated nearly 70 percent of the merchantable lodgepole pine had been killed by the beetle between 1973 and 1978 (Gibson and Bennett 1978).

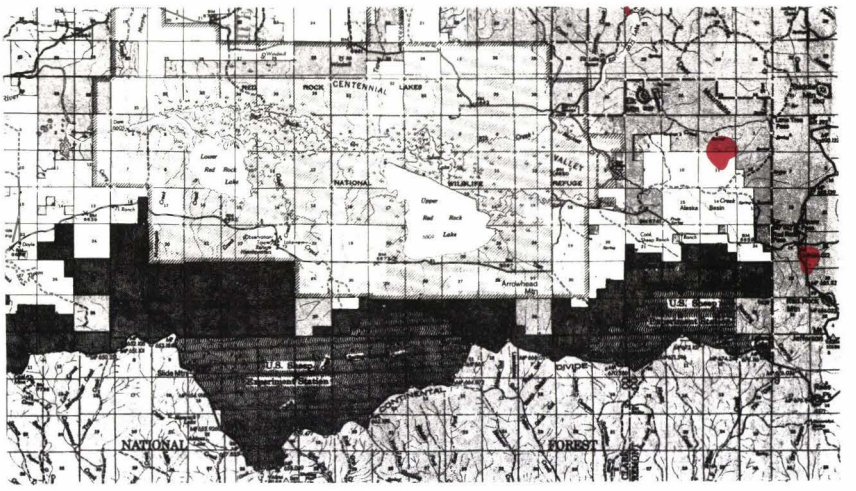
A multistage sampling survey was completed for the mountain pine beetle infestation on the Gallatin-Beaverhead National Forests in June, 1979. Though the data is preliminary, it shows about 1.3 million trees killed in the 270,000-acre infestation in 1977. Another 1.2 million trees were killed in 1978 (Bennett and Bousfield 1979).

Our annual aerial and ground surveys indicate that many of these older infestations are now waning, or will begin to decline in the next few years as susceptible host material is depleted. As this occurs, beetles will continue to infest trees in adjacent areas where lodgepole pine of sufficient age, size, and phloem thickness still exist. One such area is the southeastern portion of Centennial Valley. The extreme southeastern corner of the Valley, beginning at Nemesis Mountain and extending west for about 6 miles, contains a high percentage of mature lodgepole pine which has come under attack by the mountain pine beetle in the last 3 years. The above area is managed by the Bureau of Land Management, and this biological evaluation was made at their request.

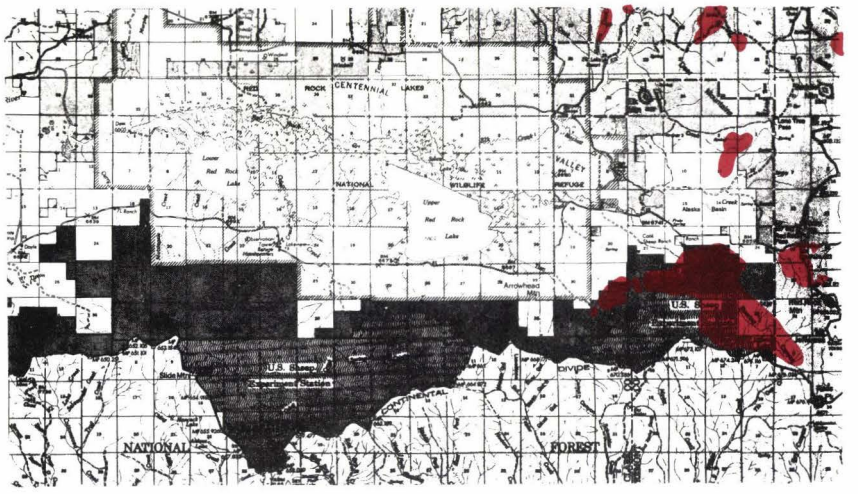
SURVEY METHODS

Aerial detection surveys for insect and disease outbreaks are conducted annually throughout the Northern Region by State and Federal personnel. These surveys cover all land ownerships within the Region's boundaries (northern Idaho, Montana, Yellowstone National Park, North Dakota, and a small portion of South Dakota). Insect infestations detected from the air are recorded on Forest maps, which are then provided to management personnel in the State, Federal, or private agencies concerned. These infestations are then visited on the ground to conduct more intensive evaluations as warranted.

Figure 1 illustrates the mountain pine beetle infestation in lodgepole pine as mapped during aerial surveillance in Centennial Valley during the past 3 years. No faded trees (those trees attacked and killed the previous year) were detected in 1976. In 1977, faders were noticed north of Alaska Basin (an estimated 200) and near Red Rock Pass (estimated at 50 trees). Total area involved in both spots was approximately 500 acres. In 1978, these infestation "spots" had increased to approximately 300 new faders north of Alaska Basin and 500 new faders at Red Rock Pass. In addition, an estimated 9,600 faders were detected along Hell Roaring Creek and westward. The infested area had increased to about 4,500 acres. The current year's map shows all areas have increased in size, except near Red Rock Pass. Also, new areas of infestation were detected southwest of Upper Red Rock Lake.



a. 1977



b. 1978

c. 1979

Figure 1.--Mountain pine beetle infestations mapped in Centennial Valley in 1977 (a), 1978 (b), and 1979 (c). Arrow (c) denotes permanent plot location.

Our estimate for new faders throughout the Valley is about 9,000 trees on more than 7,000 acres.

To augment aerial survey data, we established 30 permanent, variable radius plots within the infestation. They are located in sections 25 and 26, T. 14 S., R. 1 E. (PMM) (Figure 1c). The plots were established at 5-chain intervals (host type permitting) on two parallel transects running east and west along the northern boundary of the sections. Plot centers were identified with painted wooden stakes. "In" trees were determined using a relaskop (BAF 10) or a 10-factor prism. Each "in" tree was coded with a numbered aluminum tag, and tallied for later statistical analysis. At each plot we recorded all live "in" trees regardless of species, and all live or dead lodgepole along with its appropriate damage classification. All trees were tallied by diameter. Heights of the first two trees of each species were measured for volume estimates. In addition, regeneration data were collected from 1/300-acre plots taken at each plot center. Data were analyzed using the computer program INDIDS (Bousfield 1977). The 30 plots were established in June, 1977, prior to beetle flight. We reread the plots in September following beetle attack. They will be monitored each year after beetle flight to obtain estimates of beetle mortality and to follow the infestation's trend.

RESULTS

Tables 1-3 summarize the permanent plot data. In 1979, 47.8 trees/acre, representing 1,057.7 board feet/acre, were killed. Comparable figures for 1978 and 1977 were: 13.4 trees/acre (446.3 board feet/acre) and 9.8 trees/acre (549.8 board feet/acre) respectively. In total, 75.1 trees/acre have been killed. In the merchantable timber class (trees larger than 5" dbh), 216.7 trees/acre remain. Therefore, in just over 3 years, more than 25 percent of the merchantable lodgepole pine component of these stands has been killed. (Of the remaining green stand, 5" dbh and over, lodgepole pine comprises 77.3 percent.) This illustrates that the mountain pine beetle still has an extensive food source in this area.

Table 1.--Accumulative mountain pine beetle mortality in lodgepole pine in Centennial Valley (based on 30 variable (BAF 10) plots)

	1979	1978	1977	Pre-1977	Total
Trees/acre	47.8	13.4	9.8	4.1	75.1
Basal area	18.0	6.3	5.7	2.0	3.20
Cubic ft/ac	411.1	150.0	142.0	47.7	750.8
Board ft/ac	1,057.7	446.3	549.8	184.5	2,238.3

Table 2.--Results of data analysis, mountain pine beetle in lodgepole pine in Centennial Valley, post-beetle flight, 1979 (all figures in trees/acre)

Diameter Class	Green trees	1979 attacks	1978 attacks (new faders)	1977 attacks (old faders)	Pre-1977 attacks (snags)
1-5"	140.0	0	0	0	0
5-12"	216.3	45.7	12.8	7.9	3.3
12+"	.4	2.1	.6	1.9	.8
Total	356.7	47.8	13.4	9.8	4.1

Table 8.--Remaining green stand--all species--Centennial Valley (Based on 30 variable (BAF 10) plots. All figures in trees/acre)

Diameter class	Lodgepole pine	Subalpine fir	Douglas-fir	Engelmann spruce	Whitebark limber pine
1-5"	140.0	850.0	60.0	0	30.0
5-12"	216.3	35.3	20.4	1.3	0
12+"	.4	1.1	5.5	0	0
Total	356.7	886.4	85.9	1.3	30.0

DISCUSSION

Baker (1968) developed a method for predicting future mountain pine beetle mortality in lodgepole pine. This is determined using a "buildup ratio" of current year's to previous year's mortality. His formula for predicting mortality is: $y' = y + bx$, where:

y' = predicted mortality through next year
y = trees killed through current year
b = buildup ratio (x/x_1)
x = trees killed current year
x_1 = trees killed previous year
(Note: All figures are in trees/acre)

An application of this formula to the mortality figures shown in table 1 indicates a potential mortality estimate for 1980 of more than 170 trees/acre:

Buildup ratio (b) = x/x_1 - 47.8/13.4 = 3.57
Potential mortality in 1980 (bx) - 47.8 (3.57) = 170.65
Potential mortality through next year (y^1) = 75.10 + 170.65 = 245.75 trees/acre

While these figures seem staggering, it must be remembered that they represent potentials only. Several ameliorating factors, such as extremely cold winter temperatures, may keep them from being fully realized. Still, this predictive model has proved accurate as infestations were building in the past.

The rapidity with which the Centennial Valley infestation has built, while alarming, is not unprecedented. A review of the Targhee NF infestation shows similar development. In fact, beetles from that infestation have no doubt augmented the endemic beetle population which existed in Centennial Valley. Safranyik 1/ has identified six criteria for determining the likelihood of beetle migration into uninfested areas; they are:

1. Historic evidence of beetle activity in surrounding areas.

2. Recent beetle activity--within the past 3-5 years. Are beetle populations in surrounding areas building?

3. Stand parameters in the uninfested area. Are trees of a susceptible age and size class, and does the stand have a high percentage of host species?

4. Large contiguous areas of high-hazard, uninfested trees.

5. Major outbreaks near the uninfested area. There is much evidence to show that beetle populations do migrate into, as well as develop in, a given stand.

6. Relationship of elevation and latitude.

Many of these same criteria have been incorporated into a hazard rating system developed by Amman, et al. (1977). Their criteria for a high hazard lodgepole pine stand are:

1. Average stand age greater than 80 years.

2. Average stand diameter greater than 8 inches dbh.

3. Elevation less than 6,000 feet (at 48° N latitude).

These various factors illustrate why the beetle has increased so rapidly in Centennial Valley. Further, they support our prediction that beetle populations will continue to increase until most of the susceptible lodgepole pine has been killed in those stands--probably within the next 3 to 5 years.

1/ Safranyik,L. 1979. Personal communication.

MANAGEMENT ALTERNATIVES

Within the past several years, much valuable information has been obtained concerning manipulation of mountain pine beetle populations through appropriate stand management. Cole (1978) and Amman, et al. (1977) have stated that infested stands and high-risk stands can be managed in several ways depending upon land use objectives and stand composition. Where extensive stands contain large diameter and older age trees (high risk), they can be broken up by small organized clearcuts. This will help eliminate those stands which are conducive to large population buildups of the beetle. Where smaller stands are, or approach high risk, they should be completely removed.

Cole (1978) has summarized feasible silvicultural practices for stands where composition is pure lodgepole and form is even-aged.

1. Stocking control in young stands.

2. Organized clearcutting in blocks to create age, size, and species mosaics from mature stands.

3. Salvage or partial cuts.

4. Salvage cutting to reduce mortality in stands under attack. Amman (1976) stated, "Because the beetle concentrates heavily on trees of large diameter, continuous lodgepole forests at low elevations could be broken up into small blocks of different age and size classes, thereby reducing the area likely to be infested at any one time."

In uneven-aged pure lodgepole pine and mixed species stands, the preventive practices mentioned for pure, even-aged lodgepole pine stands are also feasible (Cole 1978). In mature mixed species stands with large lodgepole pine in the overstory, block clearcutting is recommended as a preventive to develop a mosaic pattern. If already attacked, mortality can be reduced by salvage cutting. Selective cutting to remove overstory lodgepole pine is recommended provided the residual trees are the desired species, age, and stocking level. If immature, such stands are candidates for stocking control, with species discrimination possible while reducing stand density in mixed species stands.

Discrimination against lodgepole pine is possible in older mixed stands through partial cuts in which only the most susceptible lodgepole pine portion of the main stand is removed (Cole 1978).

Partial cutting has been shown an effective treatment to reduce potential mortality in susceptible stands (Hamel and McGregor 1976; Cole and Cahill 1976; Hamel 1978). Cautions have been issued, however, for the use of partial cuts. Where timber values are primary, partial cuts for beetle management may only be appropriate where a small proportion of the lodgepole pine is high risk and where enough residual trees remain to maintain

productivity (Amman 1976). Alexander (1975) has further cautioned that lodgepole pine stands partially opened may be more susceptible to windthrow, dwarf mistletoe, and logging damage. He also states that from a silvicultural viewpoint, partial cutting practices are the only options managers have where (1) multiple-use considerations preclude clearcutting, (2) combinations of cleared openings and high forest are required to meet various forest management uses, and (3) regeneration of the stand is difficult after clearcutting.

Data (unpublished) from the Lolo National Forest shows that selective cutting--removing some large as well as small diameter trees--has prevented and reduced beetle attack along visual areas such as roads and streams. This will also lessen the siltation impact to stream channels which could be created by clearcutting. Partial cutting, whether selectively leaving large and small diameter lodgepole pine, or a straight commercial thinning based on tree diameter regardless of crown, has prevented and/or reduced incidence of beetle attack in stands on the Plains Ranger District, Lolo National Forest.

Finally, partial cutting can be applied as a last resort to after-the-fact salvage of beetle-killed trees. An increased utilization of sound material and a degree of direct control by removing beetle-infested trees would buy time to accomplish preferred block cutting (McGregor, et al. 1978)

One additional management alternative exists for those stands where single tree esthetic values are primary. In campgrounds, summer home areas, or around administrative sites, high-value trees can be successfully protected from mountain pine beetle attack through the use of a preventive spray. An application of Sevimol-4®, a water-soluble mixture of carbaryl insecticide in a molasses carrier, prior to beetle flight, has proved to be a safe, economical, and highly efficient means of protecting individual trees (Gibson 1978). Data (unpublished) suggests that a single treatment may protect trees for 2 years.

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